Finance and Banking Department

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Yarmouk University

Efficiency Measurement of Governmental Banks in Algeria with the Use of Financial Ratios Within Data Envelopment Analysis Approach

(2001-2006)

قياس كفاءة البنوك الحكومية في الجزائر بإستعمال النسب المالية و نموذج تحليل المحتوى المعلوماتي

(2006-2001)

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Submitted in partial fulfillment of the requirements of the Master's Degree in Banking and Finance at Yarmouk University

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Dedication

This thesis is a dedication to my dearest father and to my beloved tender mother, who represent everything to me.

To my sisters who mean a lot for me.

To my fiance who awaited me for a lot of time.

To all my friends.

To all who helped me in achieving this study.

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List of Abbreviations

AGB:	Algerian Governmental Banks
BA:	Bank of Algeria
BNA[1]:	Algerian National Bank
CPA:	Algerian Popular Credit
BEA:	Algerian Exterior Bank
CNEP:	National Fund for Saving and Provident
BADR:	Bank of Agriculture and Rural Development
BDL:	Bank of Local Development
DEA:	Data Envelopment Analysis
DMU:	Decision -Making Unit
CRS:	Constant Returns to Scale
VRS:	Variable Returns to Scale
SFA:	Stochastic Frontier Approach

[1] The banks abbreviations took according to French pronouncing.

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ABSTRACT

Efficiency Measurement of Governmental Banks in Algeria with the Use of Financial Ratios Within Data Envelopment Analysis Approach (2001-2006)

By: Mohamed BENAICHOUCHE
Supervisor: Prof. Ali MAGABLEH

The purpose of this study is to measure the efficiency of governmental banks in Algeria, by applying Data Envelopment Analysis (DEA) through both selected fundamental financial ratios and conventional input and output techniques, over a period 2001-2006, during which money and credit act 1990 was amended in 2001. The study aims to examining whether the large credit market share of Algerian governmental banks resulted from their high efficiency or from the governmental support.

The importance of the study is to shed light on the actual governmental strong efficient banks and how to maintain this level. In addition, it will shed light also on the weak efficient banks, with techniques of how to improve their efficiencies, helping and paving the road to investors to select appropriate investment methods in the banking sector. The sample of the study consists of all Algerian Governmental Banks (AGB), excluding only one bank due to unavailable financial statements.

The results of this study reveal that Algerian governmental banks are efficient, also the efficiency of banking sector in total shows an unstable improvement during the study period. Finally, we recommend the banks managers to reduce the non-interest expenses.

Key words: Efficiency, Banks, Financial Ratios, Data Envelopment Analysis, Algeria.

Chapter One

Introduction

1.1 Preface

1.2 Objectives of Study

1.3 Problem of Study

1.4 Importance of Study

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Chapter One

INTRODUCTION

1.1 Preface

Banking sector has an important role in the credit economy, where the financial needs are very large while financial resources are ungenerous. This case exists in economies that have weak financial markets.

Algerian economy is one of these economies; which is in the transition stage from socialism to capitalism. Therefore, the financial stock exchange market in Algeria is emerging, which makes banks as the main source of financing in the economy.

However, to make the role of this sector effective in the new economy, the government deregulated its laws, led to the establishment of private banks.

Till now, governmental banks still have the largest credit market share over privately owned banks. And the question here is whether this position is resulted from the high efficient banks or from government support.

Therefore, if these banks are highly efficient, the government should maintain this efficiency, while if these banks that are backed by government on the expenses of competitive environment, i.e. inefficient,

then these banks should be privatized, if nothing is being done about improving the efficiency of their operations.

Therefore, this study attempts to measure the efficiency of governmental banks in Algeria to classify and separate them according to this efficiency.

1.2 Objectives of the Study

The main objectives of this study are to measure the efficiency of Algerian governmental banks, and to rank these banks according to their efficiencies by using financial ratio within Data Envelopment Analysis.

1.3 Problem of Study

This study is trying to answer the following questions:

Can financial ratio discriminate efficiency between efficient banks and inefficient banks? Is the DEA inputs are sufficient in producing the required results?

Are the conventional input-output DEA and DEA Ratio Models providing similar results in measuring banks efficiency?

1.4 Importance of Study

The banking sector has an important role in financing process in Algerian economy, whose financial market is weak. Most of previous studies about Algerian banking efficiency adopted legal and reformation side while this study adopts technical tools to evaluate the bank efficiency. The importance of this study is that it gives attention to the governmental strong efficient banks and how to maintain this level of efficiency. In addition, it will shed light on the weak efficient banks and how to improve their efficiencies. On the other hand, it will help investors in their selection of investment opportunities in the banking sector.

Also, it intends to show that financial accounting ratios and non-parametric techniques can be used as a complement to each other for the evaluation of bank efficiency.

1.5 Hypotheses of Study

Hypothesis One: Algerian governmental banks are efficient in the use of its inputs to produce the actual outputs, as measured by DEA model.

Hypothesis Two: Algerian governmental banks are efficient in the use of its inputs to produce the actual outputs, as measured by financial ratios within DEA approach.

Hypothesis Three: Conventional input-output DEA and DEA Ratio Models provide similar results in measuring banks efficiency.

1.6 Structure of Study

This study is organized as follows: this chapter introduces the study. Chapter two introduces a brief review of the related literatures. Chapter three presents basic study concepts, including: background on the efficiency, financial ratio (FR) and Data Envelopment Analysis (DEA). Chapter four presents historical and structural background about Algerian banking sector. Chapter five is devoted to the data and methodology used in this study.

Finally, chapter six represents the empirical results and analysis. Conclusions and recommendations are reported in chapter seven.

Chapter Two

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Chapter Two

LITERATURE REVIEW

2.1 Introduction

Over the past decade there has been a considerable growth in studies addressing efficiency and productive in the banking sector. But few of these studies linked between the DEA and financial ratios. This study will try to measure the efficiency of governmental banks in Algeria using both financial ratios and DEA approach. In this chapter we try to review some important literatures addressed this subject.

2.2 Foreign Literature Review

Aikaeli (2006) used non-parametric DEA model to estimate the technical and scale efficiency of Tanzanian banks during 1998-2004; the used labor, capital and deposit as input, and loans, advances, and overdrafts as output. Applying a multi-product translog cost function (Stochastic Frontier Model) to estimated X-efficiency, Aikaeli results showed that efficiency status of commercial banks in Tanzania is not disappointing to the financial sector banking reforms, though banks were

not full efficient in all respects, and they still have the reasons to improve their performance.

To examine the effect of ownership structure on bank's efficiency, **Berger et. Al. (2006)** analyzed the profit and cost efficiency of banks operating in China using 266 annual observations over 1994-2003 covering 94% of banking assets (38 Chinese banks). Berger and his colleagues compared the efficiency of big four banks, non-big four state-owned banks, private domestic banks and foreign banks. They estimated efficiency levels by pooling all observations across years with principal year, and used translog functional form to estimate the cost and profit functions. The result of the study showed that the big four state-owned banks are by far least efficient, and that a minority of foreign ownership of other banks is in association with significantly improved efficiency. Therefore they recommended that minority foreign ownership of the big four state-owned banks and other reforms should take place to allow foreign banks playing a larger role so to improve the performance of the Chinese banking sector, that have potentially, positive effects on economic growth.

Pasiouras et. al. (2006) examined association between the efficiency of Greek banks and their share price performance. Efficiency score calculated using DEA method, while share performance was represented by cumulative annual stock returns. Then examined the relationship between efficiency and share performance. They regressed the annual share return price. Against the corresponding change in efficiency while controlling the size and risk. The data used in the study were the financial characteristics and monthly stock price of ten commercial banks that were listed on the "Athens Stock Exchange" between 2000 and 2005. Pasiouras and his colleagues used interest expenses and total operating expenses as inputs in DEA approach, while the total income is as an output. They found that an average technical efficiency rate over the period of the analysis was 0.931 under constant returns to scale and 0.977 under variable returns to scale, resulted in a average scale efficiency of 0.953. They also found that technical efficiency was statistically significant and positively related to stock returns, in contrast to scale efficiency that was insignificant. Pasiouras and his colleagues recommended doing a future research span over a longer period and controlling for overall conditions in the stock exchange and the economy.

Sanjeev (2006) analyzed 94 banks technical efficiency in India, between 1997 and 2001, using DEA methodology. The inputs used were "interest expenses", and "non-interest expenses", where as the outputs used were "interest income and fees", and "commission and brokerage costs". Sanjeev results show that the efficiency of the banks has improved over time and that the foreign banks have outperformed both private sector and public sector banks. Competition has increased sharply amongst the banks in the post-reform era. Therefore, it is evident that banks have responded positively to the reforms. Finally, Sanjeev concluded that the Indian banking sector is likely to witness greater thrust on reforms in the coming years.

Berger, et al. (2005) Analysed the static and dynamic efficiency of domestic, foreign and state ownership banks performance in Argentina in the 1990s. Berger and his colleagues used empirical model for testing the efficiency of corporate governance on bank performance, measured by efficiency ranks and financial ratios. Then test the effect of governance on portfolio allocation. Researchers founded that the state-owned banks have poor long-term performance (static effect), those undergoing privatization had particularly poor performance beforehand (selection effect), and these

banks dramatically improved following privatization (dynamic effect), although much of the measured improvement is likely due to placing nonperforming loans into residual entities, leaving ''good'' privatized banks.

To examine the effect of ownership structure on performance and efficiency of 225 banks in 11 traditional countries, **Bonin et al. (2005)** used unbalanced panel of 856 observations between 1996-2000. They applied Stochastic Frontier Analysis (SFA), which starts with a standard cost or profit function and estimates the minimum cost or maximum profit frontier for the entire sample from balance sheet data, to measure the efficiency of bank performance. They used return on assets (ROA) and efficiency scores to examine empirically the effect of ownership bank performance. The results showed that foreign-owned banks were more cost-efficient than other banks and that they also provided better service. The remaining government-owned banks were less efficient in providing services, which were consistent with the hypothesis that the better banks were privatized first in transition countries. Also, the results of Bonin and his colleagues study agree with results of Berger et. al. (2006).

To evaluate the impact of privatization and the ownership structure on the performance of 81 banks from 22 developing countries (which have been privatized between 1986 and 1998), **Boubakri et al. (2005)** used traditional univariate tests and panel data estimation techniques, using the main categories of variables, which are: indicators of performance, ownership structure variables, and bank and country level variables; for a period of seven years (three years prior to privatization and three years postprivatization, including the year of privatization itself). Boubakri and his colleagues study results showed that, on average, banks chosen for privatization have a lower economic efficiency, and a lower solvency than banks kept under government ownership. Where in the postprivatization period, profitability increases, but depending on the type of owner, efficiency, risk exposure and capitalization may worsen or improve, but over time, privatization yields significant improvements in economic efficiency and credit risk exposure. Finally, researchers suggest that the prevailing macroeconomic and institutional settings matter in explaining the postprivatization bank performance.

Halkos and Salamouris (2004) measuring the performance of the Greek banking sector. It explores the efficiency of Greek banks with the use of a number of suggested financial efficiency ratios for the time period 1997–1999. The ratios groups that used are the return difference of interest bearing assets, return on equity, return on total assets, profit/loss per employee, efficiency ratio, net interest margin. They also performed an application of DEA, and they used interest expenditure, total assets, number of employees ,operating expenditures as inputs, while used interest income and net profit were used as an outputs.
It departs from most frontier studies of bank performance, by using these suggested ratios as output measures and with no use of input measures. The proposed model is compared to the conventionally used input–output analysis as well as to the simple ratio analysis. This study found that: DEA can be used as either an alternative or complement to ratio analysis for the evaluation of an organization's performance, the higher the size of total assets the higher the efficiency, a wide variation in performance, and the increase in efficiency is accompanied with a reduction in the number of small banks due to mergers and acquisitions. From the efficiency results it seems that there is a non-systematic relationship between transfer of ownership and last period's performance.

Jahanshahloo et al. (2004) study was to examine the role of time in DEA efficiency analysis of multi-component decision making unit (DMU). The study represents a wide variety ways to measure the relative efficiency, progress and regress for each component of DMU, so they divide the DMU in many components. Jahanshahloo and his colleagues applied the proposed model on real data set of 39 commercial banks branches in ten towns in one region in Iran. The data was derived from operations during the first six months of 2000 and 2001, and included a number of costs and revenues figures. They used two inputs and five outputs, and used three components that involving: deposit, sales and services. As results, they had shown that the provision of the progress and regress of components of a DMU facilitates managerial actions only on those components where the DMU is underperforming .

A study conducted by **Fernandez et al. (2002)** about economic efficiency and value maximization in banking firms, DEA used to measure the economic efficiency of the firms. The sample is 142 financial intermediaries over 18 countries for the period 1989 to 1998. Results show different productivity patterns among three geographical areas (North America, Japan and Europe) over the sample period.

Sathye (2002) measured the productive efficiency of banks in India over the period 1997-1998. The methodology of this study depended on the non-parametric technique of DEA. Two models have been constructed to show how efficiency scores vary with change in inputs and outputs. The efficiency scores, for three groups of banks, that is, publicly owned, privately owned and foreign owned, are measured. The study showed that the mean efficiency score of Indian banks compared well with the world mean efficiency score and the efficiency of private sector commercial banks as a group, is a paradoxically lower than that of public sector banks and foreign banks in India. The author recommends that the existing policy of reducing non-performing assets and rationalization of staff and branches may be continued to obtain efficiency gains and make the Indian banks internationally competitive which is a declared objective of the government of India.

Sturm and Williams (2002) analyzed the effect of foreign banks entry and during post deregulation period on Australian banks efficiency for the period 1988-2001. Using DEA and Malmquist Indices, the sample included thirty-six banks. The results showed that the foreign banks

generally display superior technical efficiency due to superior scale efficiency, and The Malmquist Index results found that the post-deregulation period studied was generally one of overall efficiency improvement. Finally, the recession of the early 1990s resulted in a distinct shift in the process of efficiency changes.

Canhoto and Dermine (2000) evaluated the efficiency of 20 Portuguese banks which represent 90% of the banking industry, for the period 1990-1995. Canhoto and Dermine used DEA approach, to compare the efficiency of three groups of banks: old commercial banks, old saving banks and new banks. The outputs used in this study were loans, deposit, securities and interbank measured in Portuguese escudos, and the number of branches. The inputs include the number of employees and physical capital. Canhoto and Dermine found that the new banks did show the highest mean CRS and (VRS) efficiency of 77% (86%) compared to 62% (73%) for the old commercial banks. Where VRS is variable return to scale, And CRS is constant return to scale, so the new banks dominate old ones in term of efficiency. And they found an improvement in efficiency overtime of the order of 59% mostly driven by technological change.

Saha and Ravisankar (2000) classified the Indian commercial banks according to its efficiency through the period 1992 to1995. The analysis depended on the Data Envelopment Analysis approach (DEA). The results of the analysis indicated that, with few exceptions, the public sector banks have in general improved their efficiency scores. Also it's indicated that the findings of the present DEA study are consistent with the market perceptions about these banks.

Thanassoulis et al. (1996) compared between DEA and ratio analysis, as alternative tools for assessing the performance of organizational units such as bank branches and schools. The data used was from 1985 to 1986 in England banks. The two methods can disagree substantially on the relative performance of individual units. Ratio analysis, unlike DEA, was not found to be suitable for setting targets so that unit can become more efficient. According to the Thanassoulis and his colleagues, DEA takes simultaneous account of all resources and outputs in assessing performance while ratio analysis relates only one resource to one output at a time. However, the two methods can support each other if used jointly. The researchers found that DEA and ratio analysis is alternative methods for the assessment of the comparative performance of the organizational units.

Finaly, we can conclude that the previous studies were given many methods that can use in measuring the efficiency such as the SFA, DEA and financial ratios. While they criticized the use of the financial ratios in measuring the efficiency, but in our study we try to support the financial ratio with DEA approach to get the best efficiency measurement results.

2.3 Arabic Literature Review

Chibi and Bouzain(2006) evaluated the efficiency performance of Algerian banking sector, by giving the concept of efficiency, performance and the ratios that can be used to evaluate the banks performance, then evaluated the Algerian banking sector performance. Chibi and bouzain study examined the Algerian banking sector performance through four points: banking deposits and the GDP, the importance of the deposits to cover the banks activities, the effects of interest rates and inflation on the banks deposits, and the central bank management of the exchange reserves. Chibi and Bouzian found that: the reforms of the Algerian banking sector were very far from the required level and from the international norms (administratively, technically and technology). However, the banking sector in Algeria was very simple, where the governmental banks had 93.5% from the market. Finally, they recommended to encouraging the private banks, by permitting the governmental corporation to deposit its funds in the private banks. And give importance to the human resources development and forming banking cadres in international norms.

This study is different from the previous study since it is concerned just with Algerian governmental banks efficiency, and uses DEA approach with financial ratios to evaluate banks efficiency.

Bouabdali and khalil (2004) evaluated the return and risk performance of governmental commercial banks in Algeria. In this study, Bouabdali and her colleague recounted the historic Algerian banking sector: steps and reforms, then used return ratios and risk ratios to evaluate the performance of Popular Credit of Algeria (CPA) during the period 1997-2000. Bouabdali and her colleague found that there was an improvement in the performance of Popular Credit of Algeria (CPA) during the years, when compared this ratio with the typical sector ratio. To judge on its performance by good form, Bouabdali and her colleague recommended comparing these ratios with other local banks ratios, then with foreign banks.

The main objective of **Hayajnah (2004)** study was to measure and compare the efficiency of cash flow management of Jordanian's banks and to determine the strategies that should be followed by banks. Hayajnah used financial analysis and DEA to identifying the relatively best

performance banks and the relatively worst performing banks by ranking of Jordanian's banks. The sample of this study consisted of 14 banks out of 16 listed in Amman stock exchange. And the test period was between 1999 and 2003. Hayajnah found that the average bank performance was 53.57% according to ratio analysis. In versus, and with the use of DEA the average banks performance was 83.76%.and he recommend to use the optimal amount of assets, deposit and loans to make the using of cash flows more efficient.

the main objective of **Salhieh and Abu-Doleh (2004)** paper was to examine the relative efficiency of Jordanian banks, they utilized a performance measurement methodology (DEA), where used staff expenses, fixed assets and primes and loan-able funds as inputs variables; and credit facilities, investment, interest income and off balance sheet items as outputs variables. The sample examined in Salhieh and Abu-Doleh study includes the commercial banks and investment banks (twelve banks) that are reported in Jordanian stock market exchange from 1994 to 2000. Salhieh and Abu-Doleh study showed that Jordanian banks are in an urgent need for a comprehensive framework for measuring relative efficiency, and provided an illustration of the potential management use of DEA-efficiency as a framework for analysis.

Omran (2004) evaluated the financial and operating performance of newly privatized Egyptian state-owned enterprises, and determined whether such performance differs across firms according to their new ownership structure. Since most studies do not distinguish between the types of ownership, Omran provided new insight into that post-privatization ownership structure has impact on firm performance. The study covers 69 firms, which had been privatized between 1994 and 1998. Omran documented significant increases in profitability, operating efficiency, capital expenditures, and dividends. Conversely, significant decreases in employment, leverage, and risk found, although output showed an insignificant decrease following privatization. The empirical results also showed that Egyptian state-owned enterprises, which sold to another-investors and employee shareholder associations, seem to outperform other types of privatization, such as minority and majority initial public offerings.

Finally, this study is different from the previous studies since it is concerned with Algerian governmental banks efficiency, which is one of the first studies in Algeria using technical tools as DEA to evaluate banks efficiency, also it mixes between financial ratios and DEA.

Chapter Three

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Chapter Three
Theoretical Framework

In literature, interest in measurement of comparative efficiency of banks has grown. There are a number of papers that use non-parametric methods for determining the efficient banks. There are few studies that measure bank performance by observing the change in earnings-based financial ratios.

3.1 Efficiency: Concepts and Definitions

The concept of efficiency is widely used in engineering and in natural sciences. Engineering efficiency is defined as the ratio of the amount of work performed by a machine to the amount of energy consumed in the process. Since machines must be operated according to the law of conservation of energy, their efficiency ratios are always less than or equal to unity (Yue, 1992, p. 32).

This concept of engineering efficiency is not immediately applicable to economic production because the value of output is expected to exceed the value of inputs due to the "value added" in production. Nevertheless, under certain circumstances, an economic efficiency standard—similar to the engineering standard; can be defined and used to compare the relative efficiencies of economic entities.

A few definitions by some of the prominent scholars on the efficiency, are given below:

The performance of any institution is often evaluated in terms of its efficiency in the use of its resources. The concept of efficiency is concerned with measuring the value of output for a given level of input. In a wider context, efficiency management is concerned with fuller utilization of available inputs to achieve an optimum mix of outputs within the boundaries of feasibility in operations (Isik and Hassan, 2002, p. 722).

The efficiency of a certain decision-making unit DMU in the case of multiple input and output is established by combining all inputs and outputs into a single efficiency ratio. This ratio reflects a DMUs ability to transform all inputs into outputs simultaneously.

Efficiency can be defined in this context, as the extent to which a decision-making unit (DMU) can increase its outputs without increasing its inputs, or reduce its inputs without reducing its outputs (Chen, et al., 2005, p 232).

Farrell (1951) extended the work of Debreu (1951) and Koopmans (1951) to define a simple measure of firm efficiency, which accounts for multiple outputs. Farrell (1951) defined efficiency consisting of two

dimensions: technical efficiency and allocative efficiency. Technical efficiency reflects the ability of a firm to obtain maximal output from a given set of inputs. Allocative efficiency reflects the ability of a firm to use the inputs in optimal proportions, given their respective prices and the production technology. The above two measures when combined provide a measure of total economic efficiency (Sanjeev, 2006, p 16).

This concept is also meaningful in the case of banking operations. The efficiency of the banking industry has been a critical research stream that draws considerable attention from both academicians and policy makers.

3.2 Efficiency: Composition

Efficiency is measured with respect to an objective; it can be measured with respect to maximization of output, maximization of profits, or minimization of costs. Duality theory can be used to derive the cost function from the production function, and cost is a component of profit; hence, the three concepts are not independent. Scale economies, scope economies, and X-efficiency are different aspects of performance. Scale and scope economies refer to selecting the appropriate outputs, while X-efficiency refers to selecting the appropriate inputs (Mester, 2003, p 2).

3.2.1 Scale Efficiency

The bank has scale efficiency when it operates in the range of constant return to scale. Scale efficiency refers to how the firm's scale of operations (its size) is related to cost, i.e. what percentage increase in costs occurs with a one percent increase in scale. A firm is operating at constant returns to scale if, for a given mix of products, a proportionate increase in all its outputs would increase its costs by the same proportion; a firm is operating with scale economies if a proportionate increase in scale leads to a less than proportionate increase in cost; a firm is operating with scale diseconomies if a proportionate increase in scale leads to a more than proportionate increase in cost (Mester, 2003, p. 2).

3.2.2 Scope Efficiency

Scope efficiency occurs when the bank operates in different diversified locations. Scope economies refer to how the firm's choice of multiple product lines is related to cost. A firm producing multiple products enjoy scope economies if it is less costly to produce those products together than it would be to separate production into specialized firms (Mester, 2003, p 2).

Prior studies on scope efficiency for financial institutions are even more problematic than the scale studies. The degree of scope economies measured the percentage change in production costs if specialized firms, as opposed to a single firm produced a bank's products. If the measure is positive, scope economic exist and the bank producing multiple products is more efficient than several specialized banks. If the measure is negative, there are scope diseconomies and specialized banks operate more efficiently (Mahaftha, 2005, p 26).

3.2.3 X-Efficiency

X-efficiency measures whether banks are operating with an efficient mix of inputs, and has been the focus of recent bank efficiency studies (Chen, et al., 2005, p 232).

X-efficiency is defined as ratio of the minimum costs that could have been expended to produce a given output bundle to the actual costs expended (Mahaftha, 2005, p 27).

Banks that exhibit X-inefficiency are either wasting some of there inputs (technical inefficiency), or are using wrong combination of inputs to produce outputs (allocative inefficiency), or both (Mester, 2003, p 2).

So, X-efficiency comprises technical and allocative efficiencies. Technical efficiency for a given firm is defined as the ratio of the input usage of a fully efficient firm producing the same output vector to the input usage of the firm under consideration. Allocative efficiency measures the firm's success in choosing the cost minimizing combination of inputs. Therefore, to be fully efficient, a firm must be both technically and allocative efficient (Chen, et al., 2005, p 232).

3.2.3.1 Technical Efficiency

Technical efficiency investigates how well the production process converts inputs into outputs (Avkiran, 2006, p 276).

Technical efficiency for a given firm is defined as the ratio of the input usage of a fully efficient firm producing the same output vector to the input usage of the firm under consideration (Chen, et al., 2005, p 232).

According to Das and Ghosh (2006) the technical efficiency of a decision-making unit (DMU) refers to its success/failure in transforming inputs into outputs. It is a relative concept since its measurement requires a standard of performance against which the success/failure of the firm is assessed (Das & Ghosh, 2006, p 199).

Technical efficiency according to Koopmans is measured by the increase in any output which requires a reduction in at least one other output or an increase at least one input and vice versa. Since identification of suitable indicators for banks inputs, and output is major issue, certain ratios of costs to assets or operating revenues are used to measure a bank's efficiency (Machiraju, 2001, p 84).

So, Technical efficiency refers to the ability to produce a maximum outputs at a given level of inputs, or ability to use the minimum level of inputs at a given level of outputs.

3.2.3.2 Allocative Efficiency

Allocative efficiency is defined as the effective choice of inputs vis. a` vis. prices with the objective of minimizing production costs, that is, selection of an effective production plan. Thus, allocative efficiency can be residually calculated as the ratio of cost efficiency to technical efficiency (Avkiran, 2006, p 276).

Allocative efficiency measures the firm's success in choosing the cost minimizing combination of inputs (Chen, et al., 2005, p 232).

Allocative efficiency (AE) refers to the ability to select the optimal mix of inputs in light of given prices in order to produce a given level of outputs (Havrylchyk, 2006, p 1982).

Allocative efficiency requires the determination of prices of inputs and outputs, which can be difficult to predict in a volatile banking environment. Any estimation used for the same may or may not yield accurate observations (Sanjeev, 2006, p 15).

So, Allocative efficiency reflects the ability of a firm to use the inputs in optimal proportions, given their respective prices and the production technology.

3.3 Efficiency: Measurement

In recent literature, there is a growing body of research on efficiency measurements methods. Two streams of research can be identified:

- **Parametric Approach:** as Stochastic Frontier Analysis (SFA) which is a derivate of parametric linear regression.
- **Non-parametric Approach:** Data Envelopment Analysis (DEA).which is linear programming approach.

Depicts fundamental differences in their approach, both SFA and DEA require the specification of a cost or production function or frontier, but the former involves the specification and econometric estimation of a statistical or parametric function/frontier, while the non-parametric approach provides a piecewise linear frontier by enveloping the observed data points (Drake & Hall, 2003, p07).

DEA provides an alternative approach to regression analysis. While regression analysis relies on central tendencies, DEA is based on external observations. While the regression approach assumes that a single estimated regression equation applies to each observation vector, DEA analyzes each vector (DMU) separately, producing individual efficiency measures relative to the entire set under evaluation (Igor & Boris, 2002, p 5).

Both provide a single aggregate efficiency measurement. But DEA is better suited to evaluating efficiency and performance, because of the inflexibility of the SFA model (Berger & young, 1997).

Also, recent research has suggested that the kind of mathematical programming procedure used by DEA for efficient frontier estimation is comparatively robust. Another more simple means of producing efficiency

score is to identify all possible output-input ratios and then simply to calculate their arithmetic mean.

The aim of this study is to analyse the efficiency of DEA approach in comparing to financial ratios.

3.3.1 Data Envelopment Analysis (DEA)

DEA is a methodology for analyzing the relative efficiency and managerial performance of productive (or response) units, having the same multiple inputs and multiple outputs. It initially suggested by Farrell (1957) and later elaborated by Charnes et al (1978), Banker et al. (1984) and Fare et al. (1985). It allows us to compare the relative efficiency of banks by determining the efficient banks as benchmarks and by measuring the inefficiencies in input combinations (slack variables) in other banks relative to the benchmark. Since the mid-eighties, DEA has become increasingly popular in measuring efficiency in different national banking industries, for example in (Thanassoulis, et al., 1996), (Saha & Ravisankar, 2000), (Milind Sathye, 2002), (Hayajnah, 2004), (Pasiouras et al., 2006), (Paradi & Schaffnit, 2004) argue that DEA is the superior method for measuring overall technical efficiency.

3.3.1.1 DEA Definition

In their originating study, Charnes, Cooper, and Rhodes (1978) described DEA as a "mathematical programming model applied to observational data [that] provides a new way of obtaining empirical estimates of relations - such as the production functions and/or efficient production possibility surfaces – that are cornerstones of modern economics"

There are diverse definitions of the (DEA), e.g: (Ramakrishnan, 2006, p.157), (Wang &Yang, 2005, p.1), (Braglia, et al, 2003, p.543), (Igor & Boris, 2002, p 05), (Drake & Hall, 2003, p07) and each study explains it in different manner, so we can observe that: (DEA) developed originally as a set of techniques for measuring the efficiency of a set of decision-making units DMUs. These techniques are nonparametric in the sense they entirely based on the observed input - output data.

3.3.1.2 Efficiency Measurement with DEA

We may think of DEA as measuring the technical efficiency of a given bank by calculating an efficiency ratio equal to a weighted sum of outputs over a weighted sum of inputs. For each DMU these weights are derived by solving an optimization problem which involves the maximization of

the efficiency ratio for that DMU subject to the constraint that the equivalent ratios for every DMU in the set is less than or equal to 1.

So, according to DEA technical efficiency is defined as the ratio of the weighted sum of the **m** outputs to the weighted sum of the **n** inputs (Braglia et al., 2003, p 543).

Efficiency of DMU j

$$= E_j = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}} = \frac{\alpha_1 y_{1j} + \ldots\ldots + \alpha_m y_{mj}}{\beta_1 x_{1j} + \ldots\ldots + \beta_n x_{nj}}$$

$$= \frac{\sum_{i=1}^{m} \alpha_i y_{ij}}{\sum_{i=1}^{n} \beta_i x_{ij}}$$

Where:

α_k : is the weight of output k

β_k : is the weight of input k

y_{kj} : is the amount of output k from DMU j

x_{kj} : is the amount of input k from DMU j

The efficiency score is usually expressed as a number between 0% and 100 % (or constrained to the interval [0, 1]).a DMU with a score less than 100% is deemed inefficient relative to others. The evaluation of the efficiency of each DMU (e.g. a productive unit) requires the definition of a single and common set of weights for each plant, thus introducing the problem of how this set can be obtained.

So, Full (100%) efficiency is attained by any DMU if and only if none of its inputs or outputs can be improved without worsening some of its other inputs or outputs.

3.3.1.3 Benefits and Limitations of DEA

DEA offers some benefits to other approaches but also has some limitations that have to be kept in mind when using DEA.

According to (Halkos & Salamouri, 2004,p 204-205) and (Anderson et.al., 2002, p 599-600) the technique's main advantages are:

- DEA is powerful new technique that not only supplements traditional approaches, but also provides a more comprehensive insight into how well an organization is really performing (Norman & Stoker 1991, p 02).

- DEA technique can deal with the case of multiple inputs and outputs as well as factors, which are not controlled by individual management.
- Another important advantage of this non-parametric technique, and in general of all the non-parametric techniques, is that we skip most of the usual difficulties, which arise by the use of parametric methods in the analysis of financial ratios
- With DEA, we skip problems like the necessity to determine the functional form or to determine the statistical distribution of the ratios.
- It constructs the best practice production function solely on the basis of observed data, and therefore the possibility of misspecification of the production technology is zero.
- The application of this technique facilitates the comparison of efficiency for a large sample of banks with the simultaneous use of multiple criteria, which determine efficiency for each bank.
- One of the well-known advantages of DEA, which is relevant to our study, is that it works particularly well with small samples. As Maudos et al., (2002) point out, “Of all the techniques for measuring efficiency, the one that requires the smallest number of observations is the non-parametric and deterministic DEA, as parametric techniques specify a

large number of parameters, making it necessary to have available a large number of observations" (Maudos et al., 2002, p 511).

The main disadvantage of DEA is that the frontier is sensitive to extreme observations and measurement errors (the basic assumption is that random errors do not exist and that all deviations from the frontier indicate inefficiency). It does not allow for deviations from the efficient frontier to be a function of random error (Anderson et al., 2002, p 600).

3.3.1.4 Model Specification:

William Bowlin (2003) present some issues which are important in using DEA.

- *Positivity Property*: Generally, the DEA formulation requires that the input and output variables be positive (greater than zero).
- *Number of Decision Making Units:* A general rule of thumb is that three decision making units are needed for each input and output variable used in the model in order to insure sufficient degrees of freedom for a meaningful analysis. If less than three DMUs per input and output variable are included in the data set, there is a danger that an excessive

number of the DMUs will be considered efficient (receive a rating of one) because of an inadequate number of degrees of freedom.

- *Homogeneity of DMUs:* DEA requires a relatively homogeneous set of entities. That is all entities included in the evaluation set should have the same inputs and outputs in positive amounts (William Bowlin, 2003, p 17-19).

3.3.2 Financial Ratios

Financial ratios are widely used throughout all sectors of business and commerce. The best-known ratios are, for financial and production management, but ratios have been developed to assess marketing, purchasing, and personal management.

Ratio analysis studies and compares financial ratios, which identify relationships between quantifiable aspects of a company's activities. The object is to reveal factors and trends affecting performance so that action can be taken (Armstrong, 1986, p 523).

A financial ratio is simply a comparison of two measurements of a business to each other. For example, a measurement of income may be compared to a measurement of size. The two measurements are expressed in terms of a ratio of one number to another number. The measurements can also be expressed in terms of the percent that one is to another (Langemeier, 2005, p 1). Data for financial ratios come from the balance sheet, the cash flow statement, and the income statement.

There are many groups use financial ratio analysis, where the most interested groups are: (1) managers, who employ ratios to help analyze, control, and thus improve the firm’s operations; (2) credit analysts, such as

bank loan officers or bond rating analysts; and (3) security analysts, including both stock analysts, and bond analysts.

3.3.2.1 Financial Ratios and Bank Efficiency Measurement

In banking, ratio analysis is a technique for assessing the operating characteristics of a commercial bank by developing standardized performance measurement. For example, commercial bank manager may want to know whether the company is adequately capitalized or if sufficient profits are being generated from the assets base. To answer these and other questions about commercial banks efficiency, it is necessary to have a set of financial measures that focus on the key areas of managerial performance (Graddy & Spencer, 1990, p 186).

3.3.2.2 Financial Ratios Limitations

Caution has to be exercised in using ratios. The following limitations must be taken into account:

- A ratio is a comparison of two figures, a numerator and a denominator. In comparing ratios it may be difficult to determine where differences are due to changes in the numerator, or in the denominator or in both (Armstrong, 1986, p 531).

- Ratios are subject to the limitations of accounting methods. Different accounting choices may result in significantly different ratio values.

- While published financial statements are the most widely available source for financial analysis, the limitations inherent in their preparation (based on generally accepted accounting principles) require a basic understanding on the part of the user of how analytical results in the areas of performance and valuation can be distorted and what adjustments may be necessary (Helfert, 2001, p 56).

- Accounting data ignores the current market value of the bank and does not represent economic value-maximizing behavior.

- These financial ratios do not consider the input price and the output mix, while the selection of the weights of financial ratios is subjective (Halkos & Salamouris, 2004, p 203).

Chapter Four

Algerian Banking Sector

4.1 Introduction

4.2 Banking Sector Development

4.3 Banking Sector Structure

4.3.1 Public Banks

4.3.2 Private Banks

4.3.3 Public Versus Private Banks in Algeria

Chapter Four

Algerian Banking Sector

4.1 introduction

Algeria is currently trying to launch comprehensive structural reforms that take into account all the aspects of development: political, administrative, structural, and economic.

These reforms are a part of the so called "reform construction" (judiciary reform, reform of public administration structures and tasks, reform of the educational system). There are also policies to support economic reforms (banking and financial reforms, investment promotion, and development of agriculture), reforms of the cultural and health care systems, and in more general terms the improvement of infrastructure and all the other factors that are pre-requisites for long-term sustainable development in Algeria.

4.2 Banking Sector Development

The banking sector was a major facilitator of investment. The magnitude of the government's banking reforms can best be understood by comparing the current system with that of the French colonial era. Under

the French, most of Algeria's banks were branches of French banks; after independence they sold out or were nationalized.

The Central Bank of Algeria was established in late 1962, to replace the Colonial Bank of Algeria and act as the government's agent in financial transactions, currency issue, and other central bank functions. In 1966, Algeria nationalized the foreign banks, and transformed it to state-owned-banks (Latrache, 2007, p186).

In 1971 the Central Bank assumed the role of supervising the country's three major commercial banks, the most important of which was the Algerian National Bank (Banque Nationale d'Algérie), which served both the private and public sectors and held the bulk of total bank deposits. The other two, Algerian Exterior Bank (Banque Extérieure d'Algérie) and the Algerian Popular Credit (Crédit Populaire d'Algérie) were more sector oriented, with the former handling energy and foreign trade and the latter financing smaller sectors.

The government's economic development and decentralization policies of the 1980s resulted in the establishment of more specialized financial institutions. Bank of Agriculture and Rural Development (Banque de l'Agriculture et du Développement Rural) provided loans to the farming

and food processing industries. National Fund for Saving and Provident (Caisse Nationale d'epargne et de Prévoyance) furnished savings and housing loans. The Bank of Manufacturing and Services (Banque des Industries de Transformation et des Services) dealt with the service sector and light industries. Bank of Local Development (Banque de Développement Local) was formed in 1985 to finance communal development projects. The Algerian Development Bank (Banque Algérienne de Développement) was created in 1963 to provide long-term (ten- to twenty-year) loans (Latrache, 2007, p186-191).

At the end of 1980s, the government decides to transform the government banks to corporations.

The Law on Money and Credit of 1990 outlined the conditions for banking practices and decrees the norms which banks must conform to in order to obtain approval from the Bank of Algeria. In particular, bank funds must reach 8% of contracts settled before December 1999.

Restructuring, modernizing the payments system. Bank of Algeria is Algeria’s central bank; two amendments made in February 2001 and 2003 give more intervening power on the currency and credit council which may allow him to have influence with respect to domestic interest rates.

Algeria insists it will move ahead with reforms to the financial sector in spite of the postponement of the first sale of a state bank, a key privatization that would have gone some way to convincing doubters that the government was serious about change.

The Algiers government has gradually implemented changes to the banking sector. It has opened up to foreign groups, which make up all 12 of the private-sector banks, introduced modern payment systems and begun to restructure the six public sector banks, which account for about 95% of the sector in terms of assets and loans.

Monetary situation

This table (4-1) reports the development of monetary indicators during the 2000-2006 in billion dinars.

Table (4-1): The Development of Monetary Indicators During the 2000-2006.

unit: Algerian dinar	2000	2001	2002	2003	2004	2005	2006
lending to the business sector	993.7	1078.4	1266.8	1380.2	1535.0	1779.8	1949.8
lending to the government	677.5	569.7	578.7	423.4	-20.6	-933.2	-1310.8
money supply M2(*)[2]	2022.5	2473.5	2901.5	3354.4	3742.6	4158.3	5018.3
M2 change %	37.7%	22.3%	17.3%	15.6%	11.6%	11.1%	20.7%
liquidity ratio %	24.5%	29.3%	32.1%	32.0%	30.5%	27.6%	29.7%

Source: ministry of finance –Algeria

[2] M2: broad Money Supply

The previous table shows an increase in the lending to the business sector, also an increase in the broad money supply. Resulted from the improvement in the economy during this period. The liquidity ratio showed instability improvement during 2000-2006.

4.3 Banking Sector Structure

In Algeria, by contrast, progress in financial sector reforms has been more limited. The Algerian banking sector was officially liberalized on April 14, 1990, with the promulgation of the Currency and Credit Law. Due to the security crisis of the 1990s, it was not until late in the decade that the first private banks, both domestic and foreign, entered the market. Since then there has been some increase in the level of competition within the sector, and a basis for the development of a banking system on par with international standards has been created.

The Algerian banking sector is regulated by the central bank, bank of Algeria (BA), "Banque d'Algérie", through a subdivision known as the banking commission "Commission Bancaire". This body was in the past headed up by the minister of finance, but in a move aimed at freeing the

state banks from their traditional role as agents of governmental economic policy, the roles were officially separated in 2004 (Latrache, 2007, p 200).

There are currently 34 players operating in the Algerian banking sector, including six state-owned banks, 12 privately owned banks, and 16 finance companies.

4.3.1 Public Banks

Algeria's financial sector is dominated by government banks. The banking sector accounts for 93 percent of the assets in the financial sector, with government banks holding more than 90 percent of the banking sector's assets. There are currently six government banks, (CPA, BNA, BEA, BADR, BDL, and CNEP), which traditionally focus on financing for larger firms government corporations and real estate (in the case of CNEP). The public banks are: (Bank of Algeria, web-site)

1. Algerian National Bank (Banque Nationale d'Algérie), BNA: established in 13/06/1966.
2. Algerian Popular Credit (Crédit Populaire d'Algérie) CPA: established in 14/05/1966.
3. Algerian exterior Bank (Banque Extérieure d'Algérie) BEA: established in 01/10/1967.

4. Bank of Agriculture and Rural Development (Banque de l'Agriculture et du Développement Rural), BADR: established in 13/03/1982.

5. National Fund for Saving and Provident (Caisse Nationale d'epargne et de Prévoyance) CNEP: established in 10/08/1964.

6. Bank of Local Development (Banque de Développement Local), BDL: established in 30/04/1985.

In addition, there are five finance companies, as Algerian bank of development "Banque Algérienne de Développement" (BAD), and one co-operative assurance company, national Fund for agricultural co-operating (Caisse National de Mutualite Agricole, "CNMA"), agreed to process the bank operations.

4.3.2 Private Banks

The private commercial bank sector is recent but growing. It is made up of 12 banks today, including a semi-private bank. The number of branches is still quite small for these banks, but it is growing.

Until now the private banks are: (Bank of Algeria, web site)

1. Bank Al Baraka Algeria, "Al Baraka"
2. Arab Banking Corporation Algeria.
3. Natexis Bank.
4. Societe General Algeria.
5. CITIBANK.
6. Arab bank PLC Algeria.
7. B.N.B./Paribas El Djazair.
8. Trust Bank Algerai.
9. Gulf Bank Algeria.
10. Housing Bank for Trade and Finance, H.B.T.F.
11. Fransabank El-Djazair.
12. Calyon-Algeria-SPA.

In addition, there are eight Liaison Offices:

1. Citibank.
2. Credit Lyonnais.
3. British Arab Commercial Bank.
4. Union Des Banques Arabes Et Francaises.
5. Industriel and Commercial Credit.
6. Credit Agricole Indosuez.
7. Tunis International Bank.
8. Fortis Bank.

4.3.3 Public Versus Private Banks in Algeria

Algerian Governmental banks are dominant among the private banks in terms of assets and overall operations.

The top 10 banks include the six state-owned. The privately owned banks provide a wide range of banking services, catering for both corporate and private clients, and generally have diversified portfolios, both in terms of deposits and lending. The banking network spreads over 1278 branches, 1126 of which belong to public banks. The agencies belonging to the private banks are mostly located in large towns. The habitants to number of agencies ratio is around 26200 habitants per agency, where it was 26800 habitants per agency in 2005 and 27400 habitants per agency in 2004. This is much higher than in Europe, whose bank ratio is 5,000, demonstrating that the insufficient distribution of banking facilities (Bank of Algeria, 2007, p84).

In the end of 2006, the number of the employers was 32577 persons, including 3415 in the private banks.

After the liquidation of 2 private banks in 2003, the part of the state-owner-banks keeps very important, in 2003, 2004 and 2005 was 92.8%, 92.1% and 91.4% respectively. In end 2006, the part of state-owner-banks continues to important 91.8%.

At the end of 2006, the first governmental bank represents 36.9% of total banking sectors assets (30.6% in 2005), and the second 16.8% (17.2% in 2005), while the first two private banks represent 3.2% (2.2% in 2005)of total banking sectors assets (Bank of Algeria, 2007, p 85).

Chapter Five

Data and methodology

5.1 Introduction

The main objective of the study were to examine the efficiency of governmental commercial banks in Algeria, and the relative efficiency of each bank, by using both financial ratios and DEA techniques.

This chapter will identify the population, sample, and data collection of the study. It also provides brief explanation of the variables under investigation and their measurement. Finally, it presents the models specifications.

5.2 The Population

This study has considered all the governmental commercial banks which operating in Algeria during the test period, which is representing 92% of banking system total assets.

5.3 The Sample

According to the bank of Algeria web site, the number of governmental commercial banks operating in Algeria was six banks as following:

1. Algerian Popular Credit CPA.
2. Algerian National Bank BNA.
3. Bank of Local Development BDL.
4. Algerian Exterior Bank BEA.
5. Bank of Agriculture and Rural Development BADR.
6. National Fund for Saving and Provident CNEP.

However, BEA was excluded due to unavailable financial statements.

5.4 Data

This study considers the data of five banks operating in Algeria during the study period considered 2001-2006. This period was selected because during which money and credit act 1990 was amended in 2001.

The data used in this study are financial information, extracted and analyzed from the balance sheets and income statements which are available in the annual reports of the banks and in Bank of Algeria publications.

Also other sources were used such as articles, journals, and websites.

5.5 Methodology

We employ three steps to get at the required objectives for this study:

First stage involves the calculassions of bank efficiency scores using DEA ratio model. Then, examine the conventional input–output DEA models under same assumptions with the DEA ratio model. Finally, compared between the two models in order to see whether it provides similar results or not.

5.5.1 The Software for Calculating DEA

The data from all decision-making units DMUs and for both DEA models (ratio and (I/O) models) in this study is subject to the calculation of the Efficiency Measurement System (EMS) software based on the revised CCR model in order to obtain the DEA efficiency value. The CCR model bases the evaluation on a production technology that has constant returns to scale (CRS) and radial distance measure to the efficient frontier. Also test the input orientation.

This model presented in the methodology Charnes, et al (1978).

In this study it was assumed that macroeconomic environment developments during the relatively period considered affected all banks similarly.

5.5.2 Mathematical Formulation of DEA

Nonetheless, some mathematical understanding will be necessary to apply DEA and interpret results. Charnes, Cooper, and Rhodes (1978) generalized their model in terms of fractional linear programming formulation.

The CCR mathematical model is summarized as follows. The efficiency of a decision making unit (DMU) **K**, which utilizes multiple inputs to produce multiple outputs can be defined as: (Lewin and Seiford, 1997, p 39)

$$E_k = \frac{\sum_{r=1}^{s} U_r Y_{rk}}{\sum_{i=1}^{m} V_i X_{ik}}$$

Where,

E_k = efficiency of bank K,

U_r = weight for output r,

V_i = weight for input i,

Y_{rk} = amount of output $r = 1, \dots, s$ produced by bank K,

X_{ik} = amount of input $i = 1, \dots, m$ consumed by bank K,

s = number of outputs,

m = number of inputs.

Suppose we have **n** DMUs, where each DMUj chooses its own set of weights for both outputs and inputs to achieve Pareto optimality. The following model shows the precise form of this concept (Lewin & Seiford, 1997, p 40):

$$Max \quad E_j = \frac{\sum_{r=1}^{s} U_r Y_{rj}}{\sum_{i=1}^{m} V_i X_{ij}}$$

Subject to:

$$\frac{\sum_{r=1}^{s} U_r Y_{rj}}{\sum_{i=1}^{m} V_i X_{ij}} \leq 1 \quad ; j = 1,\ldots,n,$$

$U_r, V_i \geq 0$; r = 1,…,s; i = 1,…,m,

Where,

Ej = efficiency of bank K,

Ur = weight for output r,

Vi = weight for input i,

Yrj = amount of output $r = 1, \ldots, s$ produced by bank K,

Xij = amount of input $i = 1, \ldots, m$ consumed by bank K,

s = number of outputs,

m = number of inputs.

Depending on the orientation of the DEA model, this study the input oriented environment, the linear programming solution should be as follows (Lewin & Seiford, 1997, p 41):

$$Min \sum_{i=1}^{m} V_i X_{ij}$$

Subject to:

$$\sum_{r=1}^{s} U_r Y_{rj} - \sum_{i=1}^{m} V_i X_{ij} \leq 0 \; ; \; j = 1,\ldots,n$$

$$\sum_{r=1}^{s} U_r Y_{rj} = 1$$

$U_r \geq 0$; r = 1,…,s

$V_i \geq 0$; i= 1, …,m

Where,

Ur = weight for output r,

Vi = weight for input i,

Yrj = amount of output $r = 1, \ldots, s$ produced by bank K,

Xij = amount of input $i = 1, \ldots, m$ consumed by bank K,

s = number of outputs,

m = number of inputs.

5.5.3 DEA Models Used

5.5.3.1 Ratio DEA Model

In this step the researcher used financial banking ratios as variables to evaluate the efficiency with DEA, instead of the typically used input–output variables in almost all banking applications based on quantity input, output and prices.

Following, Halkos and Salamouris (2004, p 203) financial ratios were used throughout this part, *inter-alia*, to minimize any distortions due to inflation. This modeling constitutes an interesting alternative for efficiency evaluation and a complement to the simple ratio analysis employed by financial analysts in the banking sector.

Selection of proper variables to define and to measure financial performance is always an extremely important decision. Efficiency was measured with two inputs vector consisting of financial-banking ratios and three output (Mercan et al.,2003, p194).

The input set consists of two main items:

i. *Personnel expenses / earning assets*: (PE/EA) this ratio shows the amount that a bank spends on personnel (the most important non-financial bank input item) in order to create a unit of earning assets. It provides general information about management performance.

ii. *Total expenses / total income*: (TE/TI) indicates the efficiency of a bank in its profit generation process. It used to evaluate management performance.

The output set consisted of three main elements:

i. *Earning assets / total assets*: (EA/TA) shows the share of income generating assets in the bank's total assets. This variable evaluates the assets quality.

ii. *Equity / total liabilities:* (E/TL) is used to measure the capital adequacy and profitability. It also indicates the share of internal resources used to finance assets.

iii. *Return on equity (ROE) (net profit / equity):* This ratio shows the profitable capability of the bank and estimates the efficiency with which the bank exploits its equity.

5.5.3.2 Input-Output DEA Model

In the previous sections of this study, the proposed DEA ratio model was analytically presented. However, it is quite interesting to comparatively examine the conventional input–output (I/O) DEA models under the same assumptions with the ratio model in order to see whether it provides similar results or not.

Perhaps the most important step in using DEA to examine the relative efficiency of any type of firm is the selection of appropriate inputs and outputs. This is partially true for banks because there is considerable disagreement over the appropriate inputs and outputs for banks. Previous applications of DEA to banks generally have adopted one of two approaches to justify their choice of inputs and outputs. One is called the production approach such as Jackson and Fathi (2001), while the other is an intermediation approach such as Salamouris(2004).

Production approach views banks as institutions that use capital and labor to produce loans and deposit account services, the second approach views banks as financial intermediaries whose primary business is to borrow funds from depositors and lend those funds to others for profit.

This study followed the intermediation approach, because the intermediation approach for inputs and outputs is taken rather than the production approach, with the latter better suited to branch evaluation. Banks are viewed as financial intermediaries, which accumulate deposits and purchase funds and then intermediate these funds.

In this step the researcher used the same methodology (selection of inputs and outputs) that used by Pasiouras et al., (2006).

Due to the small number of observations in our sample, we keep the number of input and outputs as small as possible. We therefore use two inputs and one output. The two inputs are interest expenses and total operating expenses (i.e. personnel expenses, other administrative expenses, loan loss provisions). The output is the total income calculated by adding interest income and other operating income (e.g. commission income, fee income, trading income).

The next table gives a precis for variables used in related literatures used different DEA approaches.

Table (05-01) Variables Used in Related Litratures Applied DEA.[3]

studies	**Inputs variables**	**Output variables**	
Salamouris(2004) “Greek”	**Stage1:** constant **Stage2:** Interest expenditure Total assets(TA) Number of employees Operating expenditures	 Return dif. of interest bearing assets ROE Profit/loss per employee Efficiency ratio (EFF) Net interest margin Interest income Net profit	 FR IA
Sathye(2001) “Australia”	**Stage1:** Interest expenses Non- Interest expenses **Stage2:** Deposits Staff numbers	 Interest income Non- Interest income Net loans Non- Interest income	 IA IA
Jackson and fathi (2001) “Turkey”	**Stage1:** total own resources Total personnel expenses Interest & fees paid **Stage2:** Total deposit Income charges and commissions. Non-labor operating expenditure.	 Total deposit Income charges and commissions. Total loans Banking related income	 PA IA
Sanjeev (2006) “India”	Interest expenses Non-interest expenses	Interest income Fees, commission and brokerage	IA
Yalalan (1996) “Turkey”	Non-performing loans / TA Non-interest expenses/ TA	Shareholders’equity + net income/TA Net fees &commissions/TA Liquidity assets/TA	FR
Piyu Yue (1992) “Missouri”	Interest expenses Non-interest expenses Transaction deposits Non- Transaction deposits	Interest income Non-interest income Total loans	IA

PA: production approach, IA: intermediation approach, FR: Financial ratios approach

[3] The table made up by the researcher.

Chapter SIX

Data Analysis

6.1 Introduction

6.2 DEA Ratio Model Analysis

6.3 Conventional Input–Output (I/O) DEA Model Analysis

6.4 Ratio and Input-Output DEA Models Comparison

Chapter SIX

Data Analysis

6.1 Introduction

This section examines Algerian governmental banks efficiency in terms of their ability to provide outputs with minimum inputs consumption. The analysis provides two sections, DEA Ratio Model and conventional Input-Output (I/O) DEA Model.

6.2 DEA Ratio Model Analysis

Table (6-1): Descriptive Statistics of Banks Financial Ratios During 2001-2006.

Years	PE/EA	TE/TI	EA/TA	E/TL	ROE
2001	0.00608	0.95134	0.8983	0.0632	0.13262
2002	0.00656	0.96498	0.89812	0.06222	0.1102
2003	0.00694	0.97956	0.89476	0.05966	0.0448
2004	0.00832	0.9846	0.8356	0.05508	0.02806
2005	0.0084	1.01988	0.82908	0.05162	-0.07904
2006	0.00848	1.00038	0.80202	0.04736	-0.04816

Source: made up by the researcher from the appendix A.

The previous table gives average financial ratios that used as DEA inputs and outputs in measuring the bank efficiency, showed an increase in the PE/EA and TI/TA ratios during the study period. While showed a decrease in the other ratios during the study period.

Relying on financial ratios as inputs and outputs for DEA Model, the following table shows Banks efficiency scores over the period 2001-2006

Table (6-2): Descriptive Statistics of Banks Efficiency Scores During 2001-2006.

DMU	CPA	CNEP	BDL	BADR	BNA	AGB
Mean	88.85%	84.47%	84.31%	75.24%	74.21%	**81.41%**
standard deviation	0.0604	0.1212	0.161	0.118	0.0547	**0.11801**
maximum	100.00%	100.00%	100.00%	83.80%	83.27%	**88.85%**
Minimum	83.69%	74.88%	62.57%	55.30%	67.52%	**74.21%**

Source: made up by the researcher from the appendix A.

DEA Ratio Model results shows that the average efficiency scores are somehow near since they ranges between a maximum of 88.85% and a minimum of 74.21%, The geometric mean of the initial analysis amounts to 81.41%, and a standard deviation of 0.11801.

The table below summaries the total efficiency scores of banks over study period, as well as the descriptive statistics.

Table (6-3): Yearly Average Efficiency and Descriptive Statistics of DEA Ratio Model

Years	2001	2002	2003	2004	2005	2006
Mean efficiency	88.68%	89.97%	83.40%	79.12%	73.50%	73.82%
standard deviation	0.1252	0.0828	0.0793	0.0453	0.0929	0.1719
maximum efficiency	100.00%	100.00%	95.52%	83.69%	87.91%	100.00%
minimum efficiency	71.04%	83.18%	75.35%	73.63%	66.10%	55.30%

Source: made up by the researcher from the appendix C.

Average banks efficiency is 88.68% (89.68%) in 2001 (2002) respectively, while years from 2003 to 2006 witnessed a decrease in the efficiency from 83.4% to 73.82%, resulted from the large decrease in efficiency in CNEP in 2003, BDL in 2004 then BDL, BADR after 2005.

Input Orientation

The input oriented analyses in Appendix C show that all the inefficient DMUs had unused amounts in the TE/TI ratio over the study period. These unused amounts ranged between 0.12 to 0.16 in CPA, 0.15 to 0.34 in BNA, 0.02 to 0.37, 0.16 to 0.57 in BADR and 0.21 to 0.24 in CNEP.

There are remarkable large unused amounts in BNA in 2005, BDL in 2006, and BADR in 2005 and 2006.

PE/EA ratio was fully utilized in CPA, BNA and CNEP during study period. While BDL had unused amounts in 2004, 2005, 2006 and BADR 2006 because of decrease in earning assets as well as increase in personnel expenses.

Finally and from the DEA ratio results we concluded that the the average efficiency for the AGB range between 89.97% and 73.50%, and showed unused amounts in the TE/TI ratio over the study period.

So we can accept the hypothesis two, which agrees that the Algerian governmental banks are efficient in the use of its inputs to producing the actual outputs, as measured by financial ratios within DEA approach.

6.3 Conventional Input–Output (I/O) DEA Model Analysis

In this section, conventional input–output (I/O) DEA model was employed to evaluate efficiency of all banks in the study sample.

Table (6-4): Average Banks Efficiency Scores and Descriptive Statistics of (I/O) DEA Model over the period 2001-2006

Banks	BNA	CPA	BDL	BADR	CNEP	AGB
Mean	91.12%	90.34%	88.07%	86.73%	86.63%	88.58%
standard deviation	0.05621	0.05099	0.006	0.095908	0.06761	0.06103
maximum	98.72%	100.00%	88.89%	100.00%	100.00%	100%
minimum	85.20%	86.04%	87.44%	72.08%	82.51%	72.08%

Source: made up by the researcher from the appendix D

Table (6-4) presents average efficiency of each bank obtained from conventional (I/O) DEA Model, as well as the descriptive statistics during the period 2001-2006.

(I/O) DEA results show that the average witnessed low variability in efficiency. Where banks efficiency average ranged between 83.63% (CNEP) and 91.12% (BNA). The geometric mean of the initial analysis amounts to 88.58%, standard deviation is 0.06103.

Table 6-5 presents average annual efficiency scores of each bank obtained from conventional (I/O) DEA model. , as well as the descriptive statistics.

Table (6-5): Yearly Average Efficiency scores and Descriptive Statistics of (I/O) DEA Model

Years	2001	2002	2003	2004	2005	2006
Mean	90.57%	88.57%	86.75%	86.45%	90.81%	88.30%
standard deviation	0.0634	0.0452	0.0181	0.0280	0.0646	0.1163
maximum	100.00%	96.49%	88.89%	89.20%	100.00%	100.00%
minimum	85.20%	85.55%	84.10%	82.67%	82.51%	72.08%

Source: made up by the researcher from the appendix D.

The efficiency of the banking sector in total shows unstable improvement during the period 2001-2006. As it can be seen in Table 06-04, average annual banks' efficiency decreased from 90.57% in 2001 to 86.45% in 2004 with a remarkable improvement in 2005 and 2006 to because of some banks improvement in its income while other banks decreased its expenses.

Table 6-6 gives a clear and complete picture of relative efficiency for study sample during study period 2001-2006, as well as the descriptive statistics of efficiency scores.

Table (6-6): Efficiency Scores of AGB and Descriptive Statistics of (I/O) DEA Model

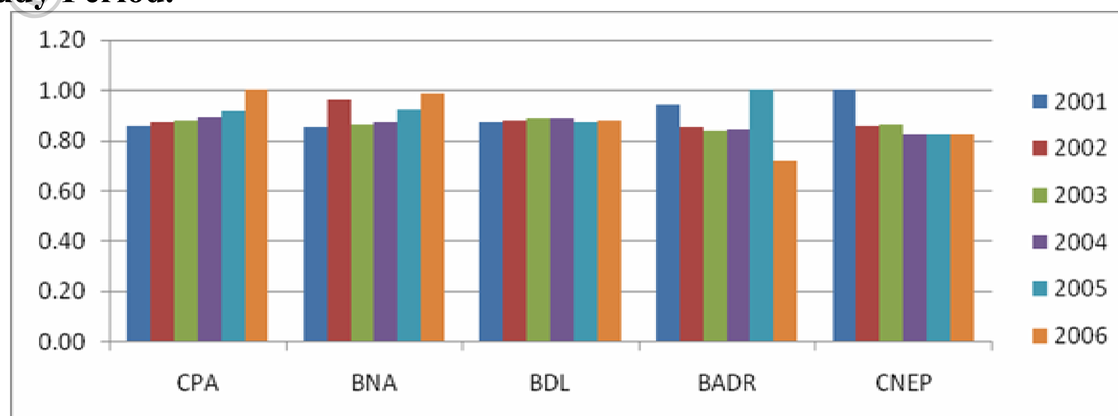
Banks	BNA	CPA	BDL	BADR	CNEP
2001	85.20%	86.04%	87.44%	94.19%	100.00%
2002	96.49%	87.31%	87.75%	85.55%	85.76%
2003	86.66%	87.87%	88.89%	84.10%	86.25%
2004	87.26%	89.20%	88.69%	84.44%	82.67%
2005	92.37%	91.62%	87.57%	100.00%	82.51%
2006	98.72%	100.00%	88.08%	72.08%	82.60%
Mean	**91.12%**	**90.34%**	**88.07%**	**86.73%**	**86.63%**
Ranking	**1**	**2**	**3**	**4**	**5**
standard deviation	**0.05621**	**0.051**	**0.00601**	**0.09591**	**0.06761**
Maximum	**98.72%**	**100.00%**	**88.89%**	**100.00%**	**100.00%**
minimum	**85.20%**	**86.04%**	**87.44%**	**72.08%**	**82.51%**

Source: made up by the researcher from the appendix D.

As table shows, banks CNEP in 2001, BADR in 2005 and CPA in 2006 were fully efficient.

Figure (06-01), presents the efficiency scores development of each bank included in the analysis over the study period.

Figure (6-1): Banks Efficiency Scores Development during the Study Period.



From CPA and BNA it can be concluded that there is a significant improvement in efficiency during the study period.

However, it should be noted that the improvement in CPA and BNA efficiency is attributed more to the significant increase in revenues and less extent to the reduction in the interest expenses, which appear to be increasing over the study period.

CPA improved its income from 39 538 millions in 2001 to 62899 millions in 2006, at the same time it decreased its interest expenses from 12370 millions to 4762 millions.

While BNA decrease its interest expenses from 133640 millions to 4895 millions over the period of the study. And decreased its non interest expenses from 40000 millions in 2002 to 25265 millions in 2006.

While there are stability in the BDL efficiency over the period of the study, which is near to 88% because of the balancing between revenues and expenses.

In particular, there is a decrease in BADR and CNEP efficiency over the study period.

It should be noted that the decrease in the efficiency of BADR bank is attributed more to the decrease in revenues compared to expenses in 2001 to 2004, while it shows losses in 2005 and 2006.

Input Orientation

The inputs orientation can be interpreted to show how much each bank could reduce its inputs usage without reducing outputs, to be full efficiency.

According to appendix D the input oriented analyses shows the following results:

I. CPA

There are unused amounts in non-interest expenses during 2000 to 2005; it decreased from 21.8% (from total non-interest expenses) in 2001 to 9.52% in 2005, where it is fully utilized in 2006. Interest expenses were fully utilized in all years.

II. BNA

There are unused amounts in non-interest expenses in all years. It decreased from 23.78% (from total non-interest expenses) in 2001 to 1.57% in 2006. It should be noted that it decreased to 4.67% in 2002. Interest expenses were fully utilized in all years.

III. BDL

There are unused amounts in non-interest expenses in all years. Amounted to 15.79% , 15.44%, 13%, 12.97%, 14.13% and 13.27% during the study period. Interest expenses were fully utilized in all years.

IV. BADR

There are unused amounts in non-interest expenses, reached 5.81%, 14.45%, 26.05%, 24.09%, and 33.93% in 2001, 2002, 2003, 2004, and 2006, while it is fully utilized in 2005.

Also, there are unused amounts in interest expenses in 2001 and 2002, reached to 29.03% and 21.28% respectively, while it is fully utilized in other years.

V. CNEP

There are unused amounts in non-interest expenses, reached to 19.99 %, 20.41%, 20.72%, 24.09, 19.90 %, 20.15% in 2002, 2003, 2004, 2005, 2006 respectively, where it is fully utilized in 2001.

Also, there are unused amounts in interest expenses in 2004, 2005 and 2006 reached to 13.32%, 14.72% and 14.19% respectively, where it is fully utilized in other years.

Finally and from the conventional input-output DEA model results, we concluded that the average efficiency for the AGB range between 90.81% and 86.45%, also showed unused amounts in the non-interest expenses over the study period.

So we can accept the hypothesis one, which agrees that Algerian governmental banks are efficient in the use of its inputs to producing the actual outputs, as measured by DEA model.

6.4 Ratio and Input-Output DEA Models Comparison

It appears in appendies C and D, the (I/O) DEA model give high efficiency scores among the DEA ratio models since only three observations appear to be fully efficient for the study period.

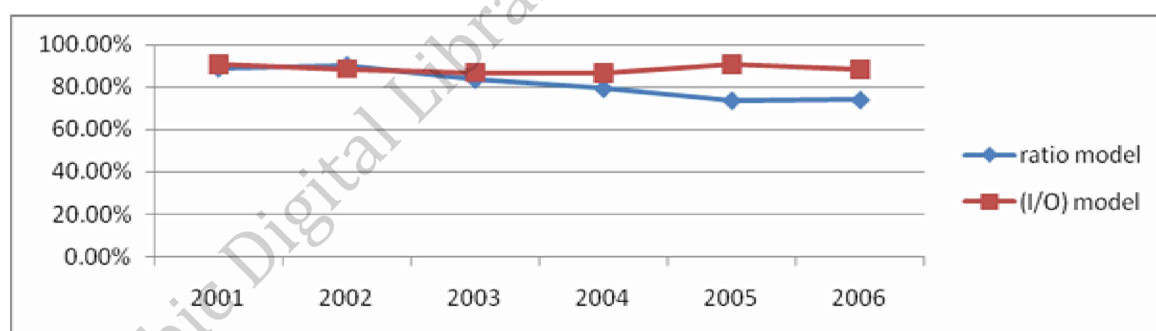
Table (6-7): Comparative Ratio Model and (I/O) Model Yearly Average Efficiency During 2001-2006.

Years	Ratios Model	Inp/Out Model
2001	88.68%	90.57%
2002	89.97%	88.57%
2003	83.40%	86.75%
2004	79.12%	86.45%
2005	73.50%	90.81%
2006	73.82%	88.30%
Mean	**81.41%**	**88.58%**
standard deviation	**0.0715**	**0.0184**
Maximum	**89.97%**	**90.81%**
Minimum	**73.50%**	**86.45%**

Source: The table made up by the researcher.

Average efficiency banking sector as derived from the (I/O) DEA Model shows a decrease from the year 2001 to the year 2004 while increased in 2005 then decreased in 2006. Ratio Model results show a decrease in the efficiency from 2001 to 2005, with a slight increase in 2002. While from 2005 to 2006 the mean efficiency scores remain almost the same.

Figure (6-2): Yearly Average Efficiency Comparison of DEA Models



By comparing average yearly efficiency scores of AGB similar results can be concluded under both models for the period 2001-2004, while a small difference appears in 2005 and 2006 can be attributed to some negative financial ratios at these years.

Where R-Square between the two previous variables is 0.16, and the P-Value is 0.99.

Table (6-8): Comparative Ratio Model and (I/O) Model Banks Average Efficiency during 2001-2006.

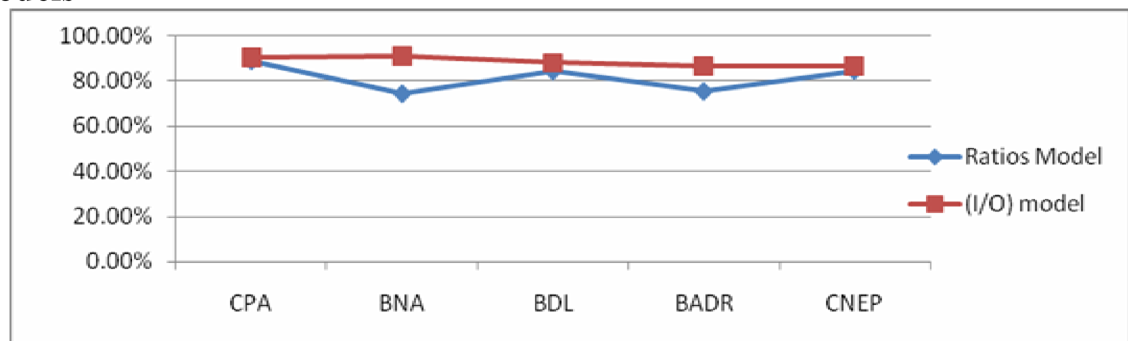
Banks	Ratios Model	Input/Output Model
CPA	88.85%	90.34%
BNA	74.21%	91.12%
BDL	84.31%	88.07%
BADR	75.24%	86.73%
CNEP	84.47%	86.63%
Mean	**81.41%**	**88.58%**
standard deviation	**0.0639**	**0.0206**
Maximum	**88.85%**	**91.12%**
Minimum	**74.21%**	**86.63%**

Source: made up by the researcher.

By comparing average banks efficiency scores of AGB, similar results can be concluded under both models for CPA, BDL, and CNEP, while a small difference appears for BNA, and BADR this can be attributed to some negative financial ratios at these banks.

Where R-Square between the two previous variables is 0.41, and the P-Value is 0.97.

Figure (6-2): Banks Average Efficiency Comparison of DEA Models



Finally, from Ratio and Input-Output DEA Models Comparison results, we can accept the Hypothesis three, which agrees that conventional input-output DEA and DEA Ratio Models provide similar results in measuring the banks efficiency.

Chapter Seven

Results and Recommendations

7.1 Results

7.2 Recommendations

7.1 Results

This study utilized the application of Data Envelopment Analysis to the Algerian governmental banks, by using standard ratios measures of bank financial performance, as inputs and over the period 2001-2006. The analysis obtained the efficiency scores, the optimal inputs (ratios) levels for inefficient bank over the study period. Results drawn from the broadly used financial ratios were also compared to the results derived from conventional Input–Output (I/O) DEA Model.

More specifically the results derived from the two analyses are similar with three banks, where a small difference was appears in the other two banks because of some negative financial ratios at these banks.

In particular this study shows that ratio analysis and DEA can be used and it is probably recommended to use them as complements to each other for the evaluation of performance of DMUs.

Additionally, it is worth mentioning that we should also take into consideration that a drawback of both ratio analysis and DEA technique is that they rely on accounting data and not on market values.

Other significant findings of this study are the following:

1. The efficiency score for the AGB rang between 90.81% and 86.45% during the period of the study.

2. Average efficiency over the period of our analyses was greater then 88% under (I/O) DEA model and 81.5% under DEA ratio model.

3. Over the study period and for all inefficiency banks had unused amounts at the (total expenses / total income) ratio.

4. There were unused amount in non-interest expenses over the study period and for all inefficiency DMUs.

5. The reduction in non-interest expenses could be considered as the means for improvement of banks' competition in the next years.

6. BNA has the best average efficiency then CPA, BDL, BADR then CNEP.

7.2 Recommendations

1. Bank managers should improve the (TE/TI) ratio and (PE/EA) ratio to get at the optimal levels, in order to maximize their efficiency.

2. The reduction in personnel expenses and non-interest expenses could be considered as the means for improvement of banks' competition in the following years.

3. Ministry of finance should review its decision of privatizing the CPA, because it have a good efficiency level that is preferred to be retained.

4. The bottom line is that the efficiency of banks must be evaluated by using both a financial ratios and DEA.

5. Future research could span over a longer period and test before and after the monetary reforms. It would also be worthwhile to undertake a similar analysis for private and foreign banks and compare the results.

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Appendix A

Inputs and Outputs of DEA Ratio Model.

banks	Years	PE/EA {I}	TE/TI {I}	EA/TA {O}	E/TL{O}	ROE{O}
CPA	*2001*	0.0049	0.9742	0.9496	0.0712	0.0417
	2002	0.0052	0.9748	0.9409	0.0692	0.0416
	2003	0.0054	0.9722	0.9376	0.0668	0.0499
	2004	0.0059	0.9709	0.9267	0.0642	0.0540
	2005	0.0062	0.9515	0.9493	0.0646	0.0982
	2006	0.0052	0.8744	0.9464	0.0705	0.2296
BNA	*2001*	0.0051	0.9808	0.8207	0.0273	0.0613
	2002	0.0052	0.8849	0.8678	0.0340	0.4152
	2003	0.0051	0.9801	0.8927	0.0322	0.0453
	2004	0.0051	0.9796	0.8495	0.0273	0.0399
	2005	0.0055	1.0478	0.8333	0.0300	-0.1618
	2006	0.0052	0.8735	0.7453	0.0296	0.2058
BDL	*2001*	0.0101	0.9835	0.8533	0.1041	0.0322
	2002	0.0123	0.9796	0.7826	0.1011	0.0347
	2003	0.0124	0.9766	0.8274	0.0963	0.0501
	2004	0.0183	0.9816	0.5836	0.0844	0.0345
	2005	0.0186	0.9954	0.5866	0.0734	0.0091
	2006	0.0185	0.9926	0.5697	0.0654	0.0161
BADR	*2001*	0.0067	0.9968	0.9005	0.0740	0.0028
	2002	0.0068	0.9965	0.9417	0.0698	0.0031
	2003	0.0074	0.9917	0.9488	0.0684	0.0084
	2004	0.0078	0.9936	0.9386	0.0637	0.0063
	2005	0.0072	1.1065	0.8615	0.0556	-0.3453
	2006	0.0090	1.2640	0.8233	0.0383	-0.6981
CNEP	*2001*	0.0036	0.8214	0.9674	0.0394	0.5251
	2002	0.0033	0.9891	0.9576	0.0370	0.0564
	2003	0.0044	0.9772	0.8673	0.0346	0.0703
	2004	0.0045	0.9973	0.8796	0.0358	0.0056
	2005	0.0045	0.9982	0.9147	0.0345	0.0046
	2006	0.0045	0.9974	0.9254	0.0330	0.0058

Appendix B

Inputs and Outputs of (I/O) DEA Model.

banks	Years	Interest expenses {I}	non-Interest expenses {I}	total income {O}
CPA	2001	12,370,623,144	26,148,485,315	39,538,281,378
	2002	9,620,000,000	31,286,654,505	41,965,654,505
	2003	9,729,277,772	35,564,258,168	46,590,786,883
	2004	6,584,772,246	40,769,427,814	48,774,975,462
	2005	5,500,374,245	47,868,817,728	56,090,938,425
	2006	4,762,899,705	50,234,068,616	62,899,071,428
BNA	2001	13,365,884,299	26,126,299,104	40,265,441,089
	2002	11,311,037,633	40,654,535,340	58,728,061,355
	2003	9,559,000,000	29,219,000,000	39,564,000,000
	2004	7,106,629,608	26,587,763,761	34,395,695,700
	2005	4,589,672,910	60,158,557,669	61,793,394,733
	2006	4,895,007,788	25,265,560,509	34,527,356,970
BDL	2001	4,791,261,495	22,116,075,444	27,359,886,575
	2002	4,345,063,056	19,810,295,470	24,658,677,571
	2003	3,976,232,164	27,701,285,931	32,436,222,494
	2004	3,105,122,459	25,060,515,369	28,693,891,966
	2005	3,069,306,193	26,609,609,536	29,816,335,785
	2006	2,766,733,219	28,969,786,519	31,972,126,917
BADR	2001	15,172,392,886	14,709,921,683	29,978,289,378
	2002	13,983,221,234	16,556,248,340	30,645,477,611
	2003	12,165,221,234	22,610,936,574	35,068,962,357
	2004	10,895,278,088	23,602,022,538	34,719,144,940
	2005	6,589,294,517	119,008,781,291	113,507,149,932
	2006	6,131,342,968	70,470,535,449	60,601,035,468
CNEP	2001	18,422,394,000	23,704,737,000	51,288,512,000
	2002	23,687,969,000	69,615,500,000	94,331,659,000
	2003	16,809,171,000	41,179,832,000	59,342,091,000
	2004	18,003,610,871	25,327,641,780	43,447,594,910
	2005	21,917,947,570	30,027,428,798	52,040,137,785
	2006	19,551,016,730	27,033,541,939	46,704,342,963

Appendix C

Efficiency Scores, Input Oriented and Feasible Targets of DEA Ratio Model

Banks	Years	score	{S} PE/EA {I}*	{S} TE/TI {I}*	targetsPE/EA **	targetsTE/TI **
CPA	*2001*	91.00%	0	0.13	0.0049	0.8442
	2002	85.50%	0	0.14	0.0052	0.8348
	2003	84.99%	0	0.15	0.0054	0.8222
	2004	83.69%	0	0.16	0.0059	0.8109
	2005	87.91%	0	0.12	0.0062	0.8315
	2006	100.00%	-	-	-	-
BNA	*2001*	71.04%	0	0.28	0.0051	0.7008
	2002	83.27%	0	0.15	0.0052	0.7349
	2003	77.33%	0	0.22	0.0051	0.7601
	2004	73.63%	0	0.26	0.0051	0.7196
	2005	67.52%	0	0.34	0.0055	0.7078
	2006	72.44%	0	0.24	0.0052	0.6335
BDL	*2001*	100.00%	-	-	-	-
	2002	97.89%	0	0.02	0.0123	0.9596
	2003	95.52%	0	0.04	0.0124	0.9366
	2004	81.71%	0.01	0.18	0.0083	0.8016
	2005	68.15%	0.01	0.32	0.0086	0.6754
	2006	62.57%	0.01	0.37	0.0085	0.6226
BADR	*2001*	81.35%	0	0.19	0.0067	0.8068
	2002	83.18%	0	0.17	0.0068	0.8265
	2003	83.80%	0	0.16	0.0074	0.8317
	2004	81.68%	0	0.18	0.0078	0.8136
	2005	66.10%	0	0.38	0.0072	0.7265
	2006	55.30%	0.0059	0.57	0.0031	0.6940
CNEP	*2001*	100.00%	-	-	-	-
	2002	100.00%	-	-	-	-
	2003	75.35%	0	0.24	0.0044	0.7372
	2004	74.88%	0	0.25	0.0045	0.7473
	2005	77.80%	0	0.22	0.0045	0.7782
	2006	78.77%	0	0.21	0.0045	0.7874

*Unused amounts for each input. **The feasible targets for each input

Appendix D

Efficiency Scores, Input Oriented and Feasible Targets of (I/O) DEA Model

banks	years	score	{S} Int-Exp {I}*	{S} N-Int-Exp {I}*	targets Int-Exp **	targets N-Int-Exp**
CPA	*2001*	86.04%	6	5,700,998,777	12,370,623,138	20,447,486,538
	2002	87.31%	0	5,417,549,774	9,620,000,000	25,869,104,731
	2003	87.87%	110	5,715,316,441	9,729,277,662	29,848,941,727
	2004	89.20%	11	5,247,426,790	6,584,772,235	35,522,001,024
	2005	91.62%	2	4,559,283,746	5,500,374,243	43,309,533,982
	2006	100.00%	-	-	-	-
BNA	*2001*	85.20%	486	6,214,032,618	13,365,883,814	19,912,266,486
	2002	96.49%	0	1,898,789,292	11,311,037,633	38,755,746,049
	2003	86.66%	6	5,411,420,458	9,558,999,994	23,807,579,542
	2004	87.26%	192	4,461,521,053	7,106,629,416	22,126,242,708
	2005	92.37%	0	9,542,208,079	4,589,672,910	50,616,349,591
	2006	98.72%	0	397,260,901	4,895,007,788	24,868,299,608
BDL	*2001*	87.44%	6	3,493,107,918	4,791,261,490	18,622,967,526
	2002	87.75%	2	3,057,805,494	4,345,063,054	16,752,489,975
	2003	88.89%	80	3,600,474,559	3,976,232,083	24,100,811,372
	2004	88.69%	0	3,250,897,495	3,105,122,459	21,809,617,874
	2005	87.57%	0	3,760,160,876	3,069,306,193	22,849,448,660
	2006	88.08%	0	3,845,727,176	2,766,733,219	25,124,059,343
BADR	*2001*	94.19%	4,404,448,238	854,431,676	10,767,944,648	13,855,490,007
	2002	85.55%	2,975,628,289	2,392,394,511	11,007,592,945	14,163,853,829
	2003	84.10%	114	5,890,748,691	12,165,221,120	16,720,187,883
	2004	84.44%	1	5,685,303,864	10,895,278,087	17,916,718,674
	2005	100.00%	-	-	-	-
	2006	72.08%	36	23,902,594,557	6,131,342,932	46,567,940,892
CNEP	*2001*	100.00%	-	-	-	-
	2002	85.76%	22	13,915,817,685	23,687,968,978	55,699,682,315
	2003	86.25%	0	8,404,486,023	16,809,171,000	32,775,345,977
	2004	82.67%	2,397,607,101	5,246,852,327	15,606,003,770	20,080,789,453
	2005	82.51%	3,225,576,032	5,975,302,273	18,692,371,538	24,052,126,525
	2006	82.60%	2,775,216,968	5,447,535,175	16,775,799,762	21,586,006,764

*Unused amounts for each input. **The feasible targets for each input.

Appendix E

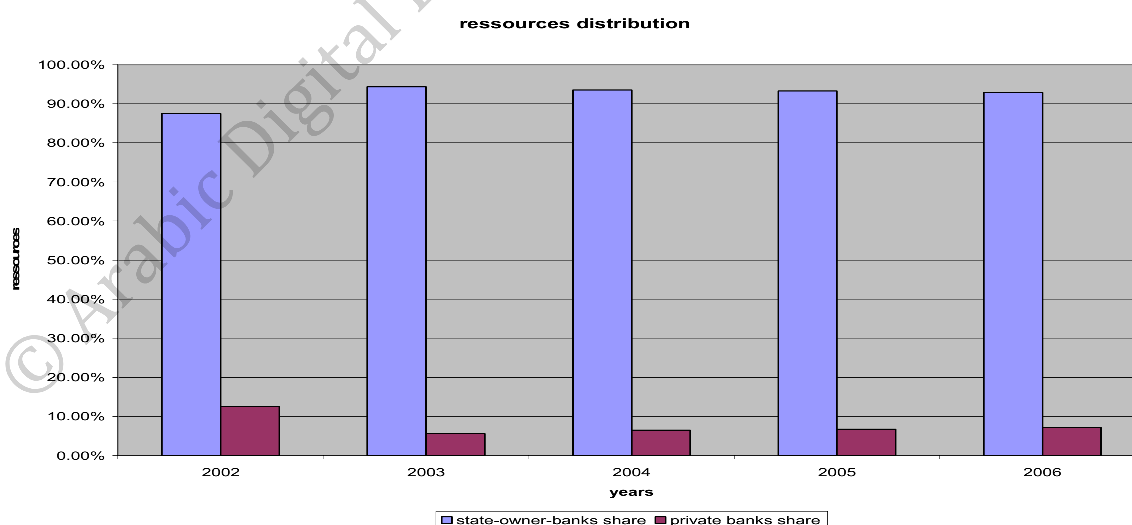
Algerian Banking System Resources and Credits Distribution

Resources: This table shows the resources distribution between the public and private banks:

(Billions diners, end of period)

	2002	2003	2004	2005	2006
short term deposits	*642.168*	*718.905*	*1,127.92*	*1224.4.3*	1,750.43
state-owner-banks	548.13	648.775	1,019.89	1,108.33	1,597.51
private banks	94.038	70.13	108.025	116.071	152.918
long term deposits	*1,485.00*	*1,724.04*	*1,577.46*	*1,736.16*	1,766.11
state-owner-banks	1,313.96	1,656.57	1,509.56	1,654.27	1,670.13
private banks	172.229	67.448	67.9	81.893	95.978
total resources	**2,127.36**	**2,442.95**	**2,705.37**	**2,960.57**	**3,516.54**
part of state-owner-banks	87.50%	94.40%	93.50%	93.30%	92.90%
pert of private banks	12.50%	5.60%	6.50%	6.70%	7.10%

Source: publications, bank of Algeria, (2007).



the Algerian Banking System Recourses Distribution

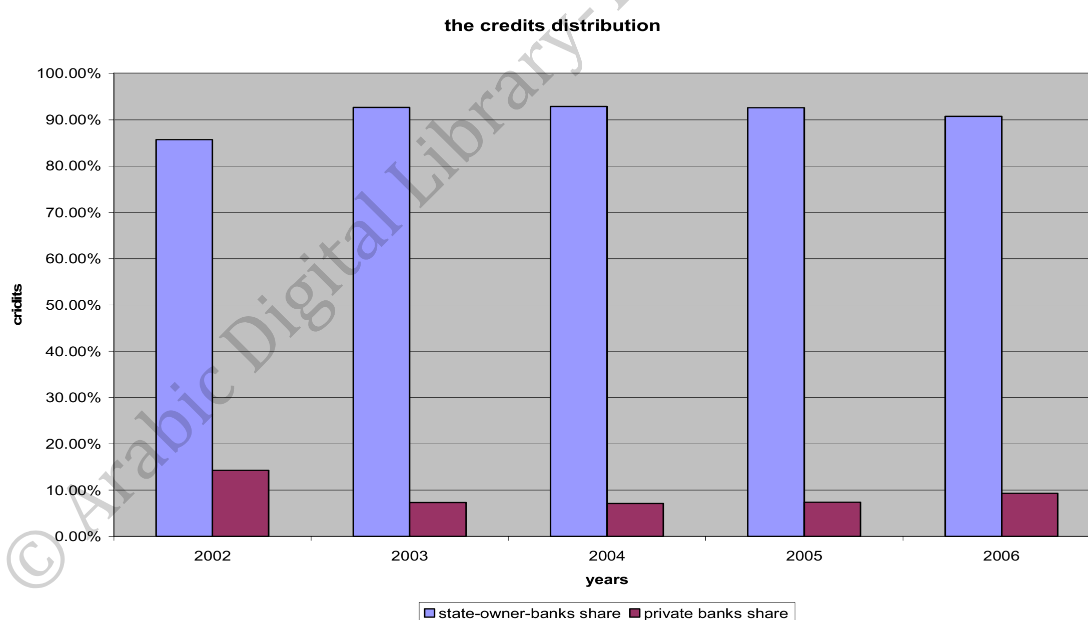
Credits:

This table shows the credits distribution between the public and private banks.

(Billions diners, end of period)

credits:	2002	2003	2004	2005	2006
credits to the public sector	*715.834*	*791.694*	*859.657*	*882.479*	848.408
state-owner-banks	715.834	791.495	856.976	881.602	847.305
private banks	0	0.199	2.681	0.877	1.103
credits to the private sector	*550.208*	*587.78*	*674.731*	*896.437*	*1,055.67*
state-owner-banks	368.956	487.74	568.605	765.316	879.275
private banks	181.252	100.04	106.126	131.121	176.419
total credits	**1,266.04**	**1,379.47**	**1,534.39**	**1,778.92**	**1,904.10**
part of state-owner-banks	85.70%	92.70%	92.90%	92.60%	90.70%
pert of private banks	14.30%	7.30%	7.10%	7.40%	9.30%

Source: publications, bank of Algeria, (2007).



The Algerian Banking System Credits Distribution

ملخص

قياس كفاءة البنوك الحكومية في الجزائر باستعمال النسب المالية ونموذج تحليل المحتوى المعلوماتي (2001-2006)

اعداد: محمد بن عيشوش
اشراف: الأستاذ الدكتور علي مقابله

تهدف هذه الدراسة إلى قياس كفاءة البنوك الحكومية في الجزائر باستخدام طريقة تحليل المحتوى المعلوماتي لكل من النسب المالية و المدخلات والمخرجات التقليدية، خلال الفترة 2001-2006، حيث جاءت بعد تعديل قانون النقد والقرض سنة 2001، لاختبار ما إذا كانت حصة سوق القروض الكبيرة التي تملكها البنوك الحكومية راجع إلى كفاءتها العالية أم إلى دعم الحكومة لها.

وتعود أهمية هذه الدراسة إلى تسليط الضوء على كفاءة البنوك الحكومية، مع ضرورة المحافظة عليها، وإلى تسليط الضوء كذلك على البنوك-ضعيفة الكفاءة وتبيان الاساليب الفنية لمعالجة الخلل فيها، من أجل مساعدة وتعبيد الطريق أمام المستثمرين لإختيار الطريق الملائم للاستثمار في القطاع المصرفي. تضم عينة الدراسة خمس بنوك حكومية جزائرية من أصل ستة بنوك، حيث تم استثناء البنك السادس لعدم توفر قوائمه المالية.

اظهرت نتائج الدراسة كفاءة البنوك الحكومية في الجزائر، مع تحسن غير مستقر في كفاءة النظام المصرفي بشكل عام خلال فترة الدراسة.أخيرا، أوصت الدراسة مسيري البنوك بتخفيض التكاليف من غير الفائدة.

الكلمات المفتاحية: الكفاءة، البنوك، النسب المالية، نموذج تحليل المحتوى المعلوماتي، الجزائر.